UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
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LVSM 7203

STUDENT OUTLINE

MAINTAIN THE MK48 ENGINE COOLING SYSTEM

LEARNING OBJECTIVES

1. Terminal Learning Objective: Given TM 2320-20/12A and partial statements pertaining to the MK48 engine cooling system, complete the partial statements to describe the procedures used to perform second echelon maintenance on the engine cooling system, per the reference. (3521.13.11)

2. Enabling Learning Objectives:

a. Given TM 2320-20/12A and partial statements pertaining to the MK48 engine cooling system, complete the partial statements to describe the procedures used to inspect the cooling system for serviceability, per the reference. (3521.13.11a)

b. Given TM 2320-20/12A and partial statements pertaining to the MK48 engine cooling system, complete the partial statements to describe the procedures used to test the MK48 engine cooling system, per the reference. (3521.13.11b)

c. Given TM 2320-20/12A and partial statements pertaining to the MK48 engine cooling system, complete the partial statements to describe the procedures used to diagnose a malfunctioning MK48 engine cooling system, per the reference. (3521.13.11c)

d. Given TM 2320-20/12A and partial statements pertaining to the MK48 engine cooling system, complete the partial statements to describe the procedures used to replace the unserviceable components of the MK48 engine cooling system, per the reference. (3521.13.11d)

OUTLINE

1. IDENTIFICATION, LOCATION AND FUNCTION OF THE COMPONENTS EMPLOYED IN THE DETROIT 8V92TA ENGINE COOLING SYSTEM

a. Radiator. The radiator is horizontally mounted above and aft of the engine. The radiator consists of a front tank, rear tank, a tube type radiator core and a filler cap.

(1) The front tank, which has a sight gage for checking the coolant level, is a reservoir that holds coolant before it enters the radiator core section.

(2) The rear tank is a reservoir that holds coolant after it leaves the radiator core section.

(3) The radiator core section is a standard fin and tube type that dissipates heat from the coolant that passes through it.

b. Radiator Cap. The radiator cap is a pressure cap that is designed to maintain 6 1/2 to 8 pounds of pressure in the cooling system. The cap is rated as a seven pound cap.

(1) All pressure caps are equipped with a vacuum relief valve which opens automatically to prevent the formation of a vacuum in the system as the vehicle's engine is cooling off. A vacuum in the system is undesirable because it can cause the radiator tanks and/or the radiator hoses to collapse.

(2) As you know, a certain amount of pressure on the cooling system is desirable because it increases the boiling point of the coolant. Thus, loss of coolant due to evaporation, surging, and unnecessary boiling is virtually eliminated. Another advantage is that the water pump works more efficiently when the system is pressurized.

c. Thermostats and Housings.

(1) The DETROIT 8V92TA engine cooling system has two thermostats. There is one thermostat and housing mounted on the front of each of the engine cylinder heads.

(2) The thermostats, functioning in the normal manner, shut off coolant flow to the radiator until the coolant temperature in the engine reaches 180 degrees Fahrenheit.

d. Water Pump. The water pump is a centrifugal type pump that circulates coolant through the engine and radiator. The water pump is mounted on the engine front cover; it is driven by the camshaft through the water pump drive gear.

e. Coolant Filter/Conditioner. The coolant filter/conditioner is a spin-on type filter that is mounted on the lower right side of the engine. This filter catches impurities suspended in the coolant. The filter also serves to condition the coolant by softening the water to minimize scale deposits, maintain an acid free condition, and act as a rust preventive. Access to the filter can be gained under the right rear fender. The coolant filter is replaced every 3000 miles or semiannually, whichever comes first.

f. Aftercooler. A unique feature of the 8V92TA engine cooling system is that it employs an aftercooler. The aftercooler is mounted on the top of the engine block, under the blower assembly.

(1) Intake air coming from the turbocharger and passing through the blower is heated by compression and an increase in velocity. That air must be cooled before induction into the engine.

(2) To cool the inlet air, air is directed through the aftercooler. The aftercooler consists of a series of finned tubing through which coolant from the engine cooling system is circulated. The hot air rushing through the openings between the finned tubes transfers its heat to the finned tubes. The coolant passing through the finned tubes carries the heat from the tubes away to the radiator for cooling.

g. Cooling Fan. The cooling fan on the MK48 is driven by a hydraulic motor and controlled by a thermal fan switch through a fan control valve.

(1) The fan and hydraulic fan motor are located under the radiator.

(2) The fan control valve is located on the rear of the engine and the fan control switch or thermal switch, is threaded into the left thermostat housing.

h. Hoses and Tubes. Of course, the engine cooling system also includes the necessary hoses and tubes, fitted with clamps to prevent leakage, to route the coolant to the various components in the system.

i. Draincocks. There are also six draincocks provided at various locations in the system for draining the coolant.

2. PRINCIPLES OF OPERATION OF THE MK48 VEHICLE'S ENGINE COOLING SYSTEM

a. When the engine starts, coolant is drawn from the rear of the radiator by the water pump. The coolant passes through the water pump into passages in the engine block, aftercooler and cylinder head. The coolant is recirculated within the engine until its temperature reaches 180 degrees Fahrenheit.

b. When the coolant reaches 180 degrees Fahrenheit, the two thermostats open and coolant is circulated into the front tank of the radiator. The action of the water pump will then pull the coolant through the radiator.

c. At the time that the coolant temperature reaches 180 degrees Fahrenheit, the fan control switch, located on the left thermostat housing, sends a signal to the fan control valve. The signal from the fan control switch opens the fan control valve, which directs hydraulic oil to the fan motor. The fan motor drives the fan and it draws air through the radiator to dissipate the heat from the coolant circulating through it. (OFF SLIDE 6)

3. SCOPE OF ORGANIZATIONAL MAINTENANCE RESPONSIBILITIES FOR THE MK48 VEHICLE'S ENGINE COOLING SYSTEM

a. Obviously, an organizational maintenance mechanic will be required to drain and fill the vehicle's cooling system.

b. Although it is not clearly established by the Maintenance Allocation Chart, you are also responsible for inspecting each of the components in the system. I am talking about a visual inspection to make certain each item is not leaking, that it functions properly, and that it is properly mounted and not damaged.

(1) You cannot see the aftercooler because it is under the blower, but you can see its outlet line.

(2) As you know, you also cannot see the thermostats, but you can determine if they are working properly by noting at what temperature the coolant starts to circulate.

(3) You can also determine if the fan circuit is functioning properly simply by noting the temperature at which the fan is actuated.

c. Another organizational maintenance responsibility is to test the radiator and cap.

d. We will wrap up the discussion of organizational maintenance responsibilities by identifying the components in the system that you are responsible for replacing. You can replace the:

(1) coolant filter,

(2) angle valve,

(3) radiator grille,

(4) thermostats and housings,

(5) fan control switch or thermal switch,

(6) high water temperature switch, and

(7) hoses and tubes.

4. SERVICING THE MK48 ENGINE COOLING SYSTEM

a. Draining the Cooling System. The first step will be to drain the radiator. Remember, you should always use extreme care to avoid being burned when working on any part of the cooling system. Wear gloves and use rags to protect yourself if you must work on a hot system.

(1) Before you remove the radiator cap, you must release the pressure in the cooling system. That is accomplished by pushing down on the radiator cap and turning it one-half turn counterclockwise.

(2) After the pressure is released, remove the radiator cap.

(3) Next, you need to open the two draincocks on the coolant tube that goes from the radiator to the water pump. Use a funnel to catch the draining coolant. In total, the cooling system capacity is twenty-seven gallons. You cannot drain the system completely because some coolant will remain in cavities in the engine, but you still must be prepared to handle a lot of the coolant.

(4) Now, in turn, open each of the four draincocks on the engine block. The draincocks are located as indicated on the SLIDE. Again, as each draincock is opened, use a funnel and pan to direct and catch the fluid.

b. Filling the Cooling System. Now let's fill the radiator. As previously stated, the capacity of the cooling system is twenty-seven gallons. If the block and radiator have been drained, you will need sufficient coolant solution to refill the system.

(1) First, make sure all six draincocks are closed.

(2) Now, fill the radiator to within one inch below the filler neck with the appropriate coolant solution.

(a) The radiator is filled with a solution of ethylene glycol and water that is appropriate to the expected temperature in the area of operation if the temperature is not expected to go below minus 55 degrees Fahrenheit.

1 As you can see on the SLIDE, you will need two and three-quarter pints of ethylene glycol for each gallon of antifreeze solution. This table is an extract from Marine Corps TI 10360-15/1 w/ch.1.

2 How many pints of ethylene glycol would be required if the capacity of the cooling system is twenty-seven gallons? You would need seventy-four and one-quarter pints.

3 How many gallons of ethylene glycol would that be? There are eight pints in a gallon so you would need nine gallons plus two pints or one quart.

(b) If the expected temperature will be below minus 55 degrees Fahrenheit, you will use an arctic type ethylene glycol. Arctic type ethylene glycol is not mixed with water.

(c) After the cooling system is filled with the correct antifreeze solution, install the radiator cap, start the engine and check the system for leaks. Recheck the coolant level after you are certain there are no leaks and add the necessary antifreeze solution to bring the coolant to the prescribed level.

5. DETERMINING THE SERVICEABILITY OF THE MK48 VEHICLE'S ENGINE COOLING SYSTEM

a. Inspecting and Testing the Cooling System. The MK48 vehicle's engine cooling system is tested and inspected in much the same manner as you would inspect any other vehicle's cooling system.

(1) The first thing that we will do is to test the radiator and cap. You will need a pressurized cooling system tester such as this one to conduct the test.

(a) The engine coolant solution should be at the prescribed level and at normal operating temperature when you test the radiator, so you will have to check the coolant level and then start and run the engine to get the temperature up to a minimum of 180 degrees Fahrenheit. Remember to chock the wheels for safety.

(b) When the operating temperature is up to normal, stop the engine and remove the radiator cap as previously instructed. Remember to use extreme caution to prevent being burned.

(c) Next, wipe the inside of the filler neck and inspect its inside sealing seat for nicks, cracks, dirt, or solder bumps. Any of those

conditions can prevent you from getting a good seal between the radiator and the tester and thus invalidate the test.

(d) Then, install the rubber filler neck plug from the test kit into the filler neck and attach the pressure tester to the filler neck. Now pump the tester until you have 10-15 pounds per square inch pressure on the system.

(e) The pressure gage can indicate many things to you.

1 If the gage holds steady for two minutes, there is no leak in the system.

2 If the pressure drops slowly, that indicates a small leak or seepage. This type of leak would normally come from hose connections or a very small hole in the radiator.

3 If the pressure drops very quickly, that would indicate a large leak that should be easy to detect because you would be losing a lot of coolant. However, if the pressure drops quickly and there is no external leak, that would indicate a problem inside the engine such as a blown head gasket. Notify your supervisor if you encounter that situation.

(f) When you have completed testing the radiator, remove the tester and the rubber plug from the filler neck.

(g) Now we will test the radiator cap.

1 The first thing to do is to install the radiator cap onto the adapter that came with the cooling system tester.

2 Then, connect the adapter to the pressure tester. Now pump the tester and note at what pressure the pressure relief valve relieves the pressure. Since this is a cap that is rated at seven pounds, the pressure should release at between 6.5 and 8 pounds per square inch. The radiator cap must be replaced if it does not meet the specifications.

3 Of course, if you discovered any discrepancies, you would correct them if you were authorized to do so; if not, you would notify your supervisor. We will assume everything was all right so you would complete the testing of the radiator and cap by removing the adapter from the radiator cap and installing the cap on the radiator.

(2) At this point you should check the radiator for debris in the radiator fins. You can normally clean out the debris by using compressed air; direct the air stream from underneath the radiator toward the top.

(3) Next, inspect the hoses, tubes, hose clamps and draincocks. The hoses should be firm but not brittle or weather checked. The hose clamps and draincocks should be secure. Look closely at all hose connection points for leaks.

(4) Now you need to check the coolant filter and the angle valve. Remember, they are under the right fender. The coolant filter should be secure and not leaking. Both shut off valves on the angle valve should be fully opened and not leaking. The valves are open when they are turned fully counterclockwise.

(5) You will also need to check the thermostat housings for signs of leakage. While checking in the area of the left thermostat housing, make sure that the electrical leads are properly attached to the fan control switch, high water temperature switch and the engine temperature sending unit. There should not be any signs of leakage around either of the switches or the engine temperature sending unit.

(6) Moving back toward the rear of the engine, check the fan control valve. There should not be any evidence of a hydraulic leak in the area of the fan control valve and the electrical leads should be properly attached to the valve.

(7) Now inspect the fan motor. It should be securely mounted and there should be no evidence of a hydraulic leak in the area of the fan motor.

(8) Complete your inspection of the engine cooling system by checking the fan. The fan blades should not be nicked or dented and the fan should not be rubbing on the fan shroud.

6. REPAIR OF THE COOLING SYSTEM BY COMPONENT REPLACEMENT

a. Coolant Filter. The coolant filter is a conventionally mounted spin-on filter that, as you know, is replaced every 3,000 miles or semiannually.

(1) Prior to removal of the coolant filter, close the two valves on the filter adapter by turning them clockwise until each valve is fully closed. This will prevent a loss of coolant during filter replacement.

(2) With the valves closed, the filter can be removed. Use a filter wrench to remove the filter. When installing the new filter, tighten it an additional one-quarter of a turn after the filter seal contacts the filter base. Do not forget to open the two valves after the filter is replaced. Always check for coolant leaks at the filter with the engine running at normal operating temperature after replacing the filter.

b. Thermostats and Thermostat Housings. Next, I will describe the procedures used to replace the thermostats and thermostat housings.

(1) Prior to removal of the thermostats, the engine access door must be opened and the engine access panels removed. You will also need to drain the cooling system, disconnect the electrical leads from the switches and the engine temperature sending unit on the left thermostat housing, and remove the throttle shut down solenoid. The removal of the throttle shut down solenoid will be covered in a separate lesson that is dedicated to the fuel system.

(2) Now, with the system drained and the other items that I mentioned taken care of, you can begin to remove the thermostats and housings. I will explain the procedure for replacing the thermostat housings; in the process, you will see how both the left and right thermostats and thermostat housings can be replaced.

(a) The first step will be to disconnect all hoses that attach to the thermostat housings by loosening the clamps. Removing the bypass tube will be easier if you first remove the front engine lifting bracket. The lifting bracket is retained by two capscrews.

(b) At this point, remove the capscrews that secure the upper thermostat housings to the lower housings. The upper right housing has five retaining capscrews and the upper left housing has four.

(c) Now, the thermostat housings can be separated. After separation, remove the gasket, thermostat and thermostat seal. Using a putty knife, scrape all the old gasket material from the thermostat housings.

(d) Complete the removal of the thermostat housings by removing the capscrews that retain the lower housings to the cylinder heads. The right thermostat housing is retained by four capscrews and the left by three. Remove the gasket and discard it. Again, use a putty knife to clean all the old gasket material from the lower housings and the cylinder heads.

(e) Installation of the thermostats and thermostat housings is accomplished in the reverse order of removal; however, all the capscrews that you will be installing are required to be torqued. Consult your vehicle technical manual for the correct torque specification. There are two other important things to remember when installing the thermostats.

1 Remember to install the seal in each of the thermostat housings with the lip of the seal facing up.

2 Also remember that the spring ends of the thermostats face down.

(f) After the thermostat housings are in place, reconnect all hoses and tighten the clamps securely.

(g) Complete the task by filling the cooling system and operating the engine to check for coolant leaks. Make sure that you get the engine up to normal operating temperature while checking for coolant leaks.

REFERENCE:

TM 2320-20/12A